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ABSTRACT

The focus of this experiment was on the effects of associative strength on retention of connected discourse, in terms of both single words and strings of words. Also of interest was the short- and long-term retention of two types of information, verbatim and substance. Verbatim information covered words and word sequences identical to those in the test passage. Substance information covered the main ideas or essential points. The subjects were 120 fifth graders from predominantly middle-class communities. Three 172-word passages were prepared which were identical except for the embedded associative pairs. The three passages had the same stimulus words, but the response words were different. Groups of subjects were assigned to one of the following four conditions: one reading, immediate testing; two readings, immediate testing; one reading, delayed testing; or two readings, delayed testing, according to a predetermined random sequence. The subjects were instructed to silently read the passage and remember as much of it as possible. A cued recall test was given immediately or 24 hours later. From the results it was concluded that no significant high-associative facilitation occurred. Furthermore, greater recall was noted across the four verbatim measures and one substance measure in the low-associative condition. (TS)

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WORD ASSOCIATION IN CONNECTED DISCOURSE

Fred Shima[1]

Mosberg and Shima (1969) discussed the problem of defining the information processing units for connected discourse, i.e., the form in which information is stored and retrieved. Defining the units is not easy since the units specified by the experimenter may not correspond to the units used by the subject. For example, in learning a simple list of words the experimenter may specify the unit of information as the single word, but the actual units encoded and stored by the subject might be short sequences of words. Tulving (1962) and Bousfield, Puff and Cowan (1964) have found that even unrelated words from a single list are grouped in free recall.

At the connected discourse level, where sequences of words are related, processing or "chunking" at the supra-word level is even more

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likely (Tulving & Patkau, 1962; McNulty, 1966). For instance, the grammatical sequence of "article-adjective-noun-verb" would suggest a chunk. Thus, specification of variables which affect formation of information units in discourse would be a logical step in understanding how information processing occurs during reading.

One variable relevant to chunking words concerns the associative connections between words. Words which are related according to word association norms tend to be clustered in free recall of simple word lists (Jenkins & Russell, 1952; Postman, Adams & Bohm, 1956; Mayzner & Tresselt, 1962). Strongly associated words tend to show greater recall than weakly associated words when those words are embedded in a reading passage (Rosenberg, 1967; 1968 a, b). Thus it appears that associative links can serve as one means of "chunking" words.

With few exceptions the associative approach has been limited to association of isolated stimulus and response words. For example, after presenting two sentences--"He went into the store, bought a Table, browsed awhile, and looked at a Chair for a few minutes before leaving" and "He went into the store, bought a Table, browsed awhile, and looked at a Lamp for a few minutes before leaving"--the highly-associated Table-Chair (69% according to the Palermo & Jenkins norms, 1964) would probably be better recalled than the low-associated Table-Lamp (less than 1%). Yet there is no evidence that high-associative units such as Table-Chair would lead to different sequences, perhaps longer sequences, of recalled words. Do associative units influence recall beyond the single word level?

Two studies by Rosenberg (1967,1968b) address this question. He found higher recall for passages with embedded high-associative word pairs than for passages with low-associative pairs, even when recall of stimulus and response words was excluded. This associative facilitation in total passage recall suggests that embedding high-associative words in connected discourse evokes larger information units. Given that more words are recalled with high-associative material and that the memory capacity for connected discourse is measured in chunks instead of single words, it seems that more words per chunk would occur in high-associative passages.

Consequently, the present experiment focused on the effects of associative strength on retention of connected discourse, in terms of both single words and strings of words. Also of interest was the short- and long-term retention of two types of information: verbatim and substance. Verbatim information covered words and word sequences identical to those in the test passage. Substance information covered the main ideas or essential points.

METHOD

Design and Subjects. A 3 x 2 x 2 independent group, factorial design was used. The three factors were (1) associative strength [high association (Hi), low association but semantically related (LoR), and low association and semantically unrelated (LoU)]; (2) trials (one or two readings of the passage before testing); (3) retention interval (immediate or 24-hour delayed testing). In the experimental design were 120 subjects, 10 per cell. The subjects were fifth-graders from predominantly middle-class communities. The California Achievement Test reading scores for subjects were obtained and a one-way analysis of variance indicated no significant difference ($p < .05$) across the 12 groups.

Materials. Three 172-word test passages were prepared and were identical except for the embedded associative pairs. The three passages had the same stimulus words but the response words were different. Associative strength for the 10 Hi responses ranged from 25-55% (median 40.5%), while the 10 low-associative responses for the LoR and the 10 for the LoU were either 0% or idiosyncratic, according to the Palermo and Jenkins (1964) fifth-grade norms. The LoR responses were selected for equivalence of meaning with the Hi responses, whereas the LoU responses were chosen for low similarity with the Hi responses. The Hi, LoR, and LoU responses had comparable Thorndike-Lorge (1944) frequency values. The Dale-Chall (1948) readability formula indicated that the passages were appropriate for the fifth-grade level (5.6 for the Hi, 5.7 for the LoR, and 5.6 for the LoU). Of the 14 sentences in each passage, 10 had an embedded associative pair. Four were nonassociative filler sentences added for passage continuity.

The Hi, LoR, and LoU associative passages are presented below. The stimulus words are in capitals and the response words are underlined to indicate the associative pairs. The associative pairs were not indicated in the versions given to the subjects.

> Hi----The DOCTOR was busy in the next room talking to the nurse. A BOY was sitting in the waiting room with a younger girl. He went to the TABLE, took a magazine, and returned to the chair. Instead of reading, he thought about last Sunday. He had taken a trip outside the CITY to a nearby town. There a small RIVER ran slowly and the water was cool. He spent the afternoon wandering across the meadow. He played in a deserted barn where he found a rusty HAMMER and nails. Then he ran through the woods with his DOGS until he came to a clearing where several cats were scared off. He examined the old, wooden cabins there. He saw a PRIEST talking to some people in a church painted white. Although he had walked a long time and his SHOES were scuffed, his feet were not tired. He stopped daydreaming and opened the magazine. As he was reading a story about a KING and his queen, the doctor called him in.

LoR----The DOCTOR was busy in the next room talking to the secretary. A BOY was sitting in the waiting room with a younger sister. He went to the TABLE, took a magazine, and returned to the sofa. Instead of reading, he thought about last Sunday. He had taken a trip outside the CITY to a nearby park. There a small RIVER ran slowly and the wind was cool. He spent the afternoon wandering across the meadow. He played in a deserted barn where he found a rusty HAMMER and pins. Then he ran through the words with his DOGS until he came to a clearing where several kittens were scared off. He examined the old, wooden cabins there. He saw a PRIEST talking to some people in a house painted white. Although he had walked a long time and his SHOES were scuffed, his legs were not tired. He stopped daydreaming and opened the magazine. As he was reading a story about a KING and his wife, the doctor called him in.

LoU----The DOCTOR was busy in the next room talking to the guest. A BOY was sitting in the waiting room with a younger lad. He went to the TABLE, took a magazine, and returned to the bench. Instead of reading, he thought about last Sunday. He had taken a trip outside the CITY to a nearby field. There a small RIVER ran slowly and the air was cool. He spent the afternoon wandering across the meadow. He played in a deserted barn where he found a rusty HAMMER and bells. Then he ran through the woods with his DOGS until he came to a clearing where several birds were scared off. He examined the old, wooden cabins there. He saw a PRIEST talking to some people in a car painted white. Although he had walked a long time and his SHOES were scuffed, his knees were not tired. He stopped daydreaming and opened the magazine. As he was reading a story about a KING and his plane, the doctor called him in.

Procedure. Groups of subjects were assigned to one of four conditions, (a) One reading-Immediate testing, (b) Two readings-Immediate testing, (c) One reading-Delayed testing, or (d) Two readings-Delayed testing, according to a pre-determined random sequence. Within each group the Hi, LoR and LoU forms were distributed in rotation. The subjects were instructed to silently read the passage (2 minutes) and to remember as much of it as possible. The groups that received two readings prior to testing were given a 30-second rest between readings. A cued recall test (15 minutes) was given immediately or 24 hours later. The delayed test groups were informed after the reading(s) that no test would be given then but that the experimenter would return the next day.

The cued recall test required subjects to write down the 14 passage sentences in order. If unable to remember the exact words, subjects were asked to write more or less what was originally presented. On the

test form were blanks in which subjects wrote the sentences, and before each of the 14 sentence blanks were two words taken from each sentence to aid subjects' recall. The cue words were always nouns, and for the 10 associative sentence blanks the two cue words were the associated stimulus and response terms in each sentence.

Scoring. Five recall measures--four verbatim and one substance--were obtained for each subject. One verbatim measure was number of content words recalled. Content words are nouns, pronouns, verbs, adjectives, and adverbs. The second verbatim measure was number of word sequences recalled. A sequence was an uninterruped series of recalled words which corresponded to a sequence of words in the original sentence. The third and fourth verbatim measures were number of words in sequence and mean length of sequences. Given several sequences, the words in those sequences were counted, and the total was then divided by the number of sequences to obtain the mean sequence length. For example, if a subject who read a Hi passage later recalled the first sentence as "A doctor was talking to the nurse next door," then the verbatim scores would be: content words, 5; sequences (underlined), 2; words in sequence, 6; and mean length of sequence, 3. The four verbatim scores were each totaled across the 14 sentences in the passage for each subject.

The measure of substance recall was the number of main points recalled. Before the experiment, each sentence was broken down into idea units, and the number of such units recalled was computed. For example, in the sentence "The doctor was busy in the next room talking to the nurse," the four idea units were: (1) doctor, (2) busy and/or talking, (3) nurse, and (4) next door. As with the verbatim scores, the idea units were totaled for the 14 sentences in the passage for each subject.

The content word and the idea unit scores did not include the content words and idea units given by the cue words on the cued recall test. In the first sentence of the Hi passage, for instance, the cue words were "doctor, nurse" so that the subject's recall of those two words did not count on the content word and idea unit scores.

RESULTS

Recall for the total passage (10 associative and 4 filler sentences) and for the set of 10 associative sentences is shown by associative level in Tables 1 and 2, and by trials and retention interval (collapsed across associative levels) in Tables 3 and 4. Separate 3 x 2 x 2 analyses of variance were done for total passage recall in terms of content words, sequences, words in sequence, mean length of sequence, and idea units. A similar set of five 3 x 2 x 2 analyses of variance was done for recall discarding the filler sentences. Since the results of the analyses for the 10 associative sentences paralleled the results for the total passage,

TABLE 1

Mean Passage Recall by Association Level

	Association		
	Hi	LoR	LoU
Content Words	20.65	24.58	22.88
Sequences	11.60	13.35	12.45
Words in Sequence	35.97	42.90	38.65
Mean Sequence Length	3.01	3.09	2.97
Idea Units	18.10	21.00	19.10

TABLE 2

Mean Recall for 10 Associative Sentences by Associative Level

	Association		
	Hi	LoR	LoU
Content Words	16.60	20.38	18.33
Sequences	9.00	10.63	9.88
Words in Sequence	29.30	35.25	31.20
Mean Sequence Length	3.20	3.20	2.99
Idea Units	13.08	15.15	13.43

TABLE 3

Mean Passage Recall by Trials and Retention Interval*

	1-Immediate	2-Immediate	1-Delay	2-Delay
Content Words	26.00	33.00	10.33	21.47
Sequences	14.03	16.43	6.60	12.80
Words in Sequence	45.37	55.87	18.20	37.27
Mean Sequence Length	3.23	3.21	2.65	2.81
Idea Units	23.23	26.80	8.70	18.87

*collapsed over associative levels

TABLE 4

Mean Recall for 10 Associative Sentences by Trials and Retention Interval*

	1-Immediate	2-Immediate	1-Delay	2-Delay
Content Words	21.40	27.33	8.03	16.96
Sequences	11.43	12.97	5.03	9.90
Words in Sequence	38.00	45.90	14.37	29.53
Mean Sequence Length	3.31	3.36	2.74	2.89
Idea Units	16.90	19.80	5.77	13.07

*collapsed over associative levels

only the passage effects are reported. Since the substance scoring of idea units involved a subjective determination of accuracy, scoring reliability was checked. Two judges independently scored the recall test for idea units. The inter-judge correlation was .99.

The two low-association groups consistently showed higher recall across the four verbatim and the substance indices. The association factor, however, was not significant in any analysis. Immediate testing led to significantly ($p < .001$) higher recall in terms of content words, sequences, words in sequence, mean length of sequences, and idea units than delayed testing, [F (1,108) = 41.14, 26.97, 34.91, 100.38, and 46.48]. Two passage readings also led to higher recall than one reading. The difference was reliable ($p < .001$) in content words, sequences, words in sequence, and idea units, [F (1,108) = 18.28, 16.29, 14.57 and 17.37]. No consistent interactions were noted, and only two statistically reliable 2-way and one statistically reliable 3-way interactions resulted across the five analyses of variance done for verbatim and substance recall.

Since the associative influence on large information units was of interest, the number of long sequences recalled (five words or more) was examined. The proportion of large chunks in the experiment was small: only 215/1,496 or 14.34% of all recalled sequences were five words or longer. A 3 x 2 x 2 analysis of variance was done for the number of long sequences. Although more long sequences were recalled in the low-association groups than in the high, the difference was not significant. Immediate testing and two passage readings resulted in significantly more long sequences than delayed testing and one reading, [F (1,108) = 26.81 and 9.14, $p < .001$ and $p < .01$]. No interactions were significant.

Serial position effects were examined by computing the proportion of content words and idea units recalled from the beginning, middle, and end of the passage. The passage was divided into three blocks of approximately the same number of words: sentences #1-5 (57 words), #6-10 (61 words), and #11-14 (54 words). A 3 x 2 x 2 x 3 analysis of variance was performed--association level x retention interval x trials x blocks. A significant ($p < .001$) blocks effect was found for both proportion of content words and idea units, [F (2,216) = 38.00 and 55.00]. Only one interaction was noted, a Blocks x Trials for content words, [F(2,216) = 6.00, $p < .01$]. Block 1 had the highest recall with one reading, but Block 3 had the highest with two readings.

Individual comparisons using the Newman-Keuls procedure were done for the block scores shown in Table 5. The difference in proportion of content words recalled between blocks 1 and 3 was not significantly different but both were significantly higher than block 2 ($p < .01$). Thus the classical serial position curve of higher initial and terminal recall was found with content words. For proportion of idea units, block 1 was significantly higher than blocks 2 and 3 ($p < .01$), and

TABLE 5

Mean Proportion Recall in Passage by Sentence Blocks

	Blocks		
	1	2	3
Content Words	.28	.19	.29
Idea Units	.52	.34	.38

block 3 was reliably higher than block 2 ($p < .05$). A strong primacy effect and slight recency tendency were therefore obtained with idea units.

Despite no statistically significant difference between associative levles, it was hypothesized that the distance between stimulus and response terms might influence retention within associative levels. Three sentences wherein four or less words (mean 3.3) intervened between the stimulus and response terms and three sentences with six or more (mean 7.0) intervening words were compared. For both short and long associative spread sets, three sentences were picked--one from the beginning, middle, and end of the passage--to avoid confounding by serial position. Proportions of content words and idea units were examined by a 3 x 2 x 2 x 2 analysis of variance--association x retention interval x trials x distance. In content words, the sentences with long stimulus-response distance showed greater recall but the difference was not significant, and distance did not interact with the other factors. With idea units, the sentences with long stimulus-response distance showed significantly higher recall, [F (1,108) = 78.50, $p < .001$.] A retention interval x distance interaction [F (1,108) = 12.50, $p < .001$] indicated that a greater decrease from immediate to delayed testing resulted with long associative spread. A trials x distance interaction [F (1,108) = 7.50, $p < .01$] indicated that a greater increase from one to two readings occurred in the sentences with long associative spread. Generally the comparison between long and short associative units suggested that associative spread leads to greater retention than associative proximity.

Some interesting results on sequences were obtained. The overall number of words in sequences seemed large. On the average, the subject recalled 39 of the 172 words in the passage in some sort of sequence.

The mean length of sequence acorss all subjects was 3.02 words, i.e., the average chunk of information was three words. The scores ranged from 1.67 to 5.25, and 81.25% of the scores were in the 2.25-3.75 range, a difference of only 1.50 words.

DISCUSSION

Contrary to findings reported in the Rosenberg studies, no significant high-associative facilitation was found. Moreover, greater recall was consistently noted across the four verbatim and one substance measures in the low-associative condition--more content words, more sequences, more words in sequence, longer mean length of sequence, and more idea units.

The conflicting results may be due to differences in test populations and test material. Whereas this study used children, Rosenberg tested adults. A developmental difference in associative effects is

possible. Also, whereas embedded S-R word pairs were used in the present study, Rosenberg inserted S-R, R, R triads. The R-R-R connections, which cannot always be found in word association norms as can the single S-R relation, may be a critical factor in associative facilitation.

In comparing the retention of verbatim vs. substance learning in terms of content words vs. idea units, the results were consistent with Cofer's (1941) early report. Using a recall procedure and learning trials as the dependent variable, Cofer found easier substance learning. In the comparable immediate testing condition here, content word recall was 32% while idea unit recall was 51%. Similar results were obtained by Yavuz (1963) in a rote learning study, where incorrect responses in paired-associate paradigms tended to have semantic ratings similar to those for correct responses. Brown and McNeill's (1966) "tip of the tongue" phenomenon also suggests that the verbatim label may be missing but the substance content remains.

Although the higher substance retention is consistent with past research, the changes from short- to long-term retention for verbatim and substance information were not. Given content word and idea unit scores at immediate testing as the baseline, the delayed testing 24 hours later indicated a 46% drop in content word recall and an almost identical 45% drop in idea unit recall. In contrast, English, Welborn and Killian (1934) reported a decrement in verbatim scores but an increment in substance scores after 30 days. Briggs and Reid (1943) found less than a 10% drop in substance memory after 12 weeks. The discrepancy in results may be partly due to the use of a recall test and independent groups for immediate and delayed testing in the present study vs. recognition tests and repeated testing in the English, et al. and Briggs and Reid reports. Recognition scores are typically higher than recall (Postman & Rau, 1957) and repeated testings may act as additional learning trials. For example, Clark (1940) and King and Cofer (1960) found that an immediate test trial tended to inflate long-term retention levels.

Another point of comparison is the mean length of sequences. Tulving and Patkau (1962) gave single presentations of 24-word sentences of high-frequency words and immediate testing, and found that the average recalled sequence was 2.75 words. For the comparable One reading-Immediate test group here, the sequence was 3.23 words. The larger chunk may be related to context facilitation; the rest of the passage aids recall of each passage sentence by setting up the content of a particular sentence in reference to sentences preceding and following it.

The experiment, consequently, led to three unexpected but interesting conclusions. First, high-associative words tended to lower overall retention of prose. No strong associative facilitation occurred in connected discourse, and if some facilitation did occur it resulted from low-associative words. Second, the greater long-term retention of

substance information, compared to verbatim information, was based on the greater initial retention of substance information and not on less forgetting of substance material. Third, chunks of information for connected discourse measured about three words and seemed to be larger than chunks from single sentences.

Although high-associative facilitation was not found, it is difficult to dismiss the associative approach to studying retention of connected discourse. Rosenberg has reported a large body of research which consistently exhibited associative facilitation, and it seems rash to consider this one study as conclusive repudiation of that research. Rather, the negative associative effects here--the low-associative facilitation--poses questions for future associative research. The broad question is not "Is there high or low-association facilitation in connected discourse?", but "Under what conditions is there high-associative facilitation or low-associative facilitation?" Two problems which might be considered are: (1) developmental differences in associative effects which could be examined by replicating the Rosenberg work with children or the present experiment with adults, and (2) the relation between passage difficulty and associative effects which could be investigated by presenting longer passages, complex sentence structure, and advanced vocabulary in passages.

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